PCT

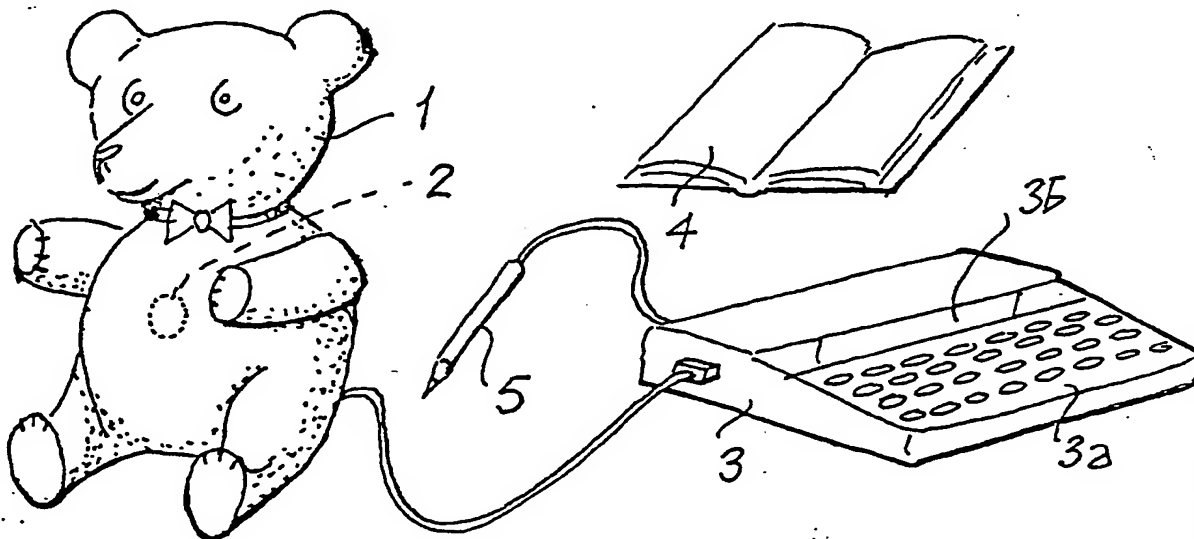## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 3 : G09B 5/06, 17/00, 11/00	A1	(11) International Publication Number: WO 83/ 02188
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(54) Title: EARLY LEARNING DEVICE

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(57) Abstract

Didactic equipment comprises a soft toy (1) provided with voicing means (2), printed text (4) with bar codes associated with at least some of the textual matter, a manually controlled reader (5) for extracting information from the bar codes and electronic processing means (3) to make the voicing means in the toy articulate on the basis of the information extracted when the reader has been passed over one of the bar codes.

- 1 -

Early learning device

This invention relates to didactic equipment and in particular to a computer-based early learning device which has utility in the teaching of reading skills and optionally also in the development of writing and/or
5 keyboard familiarity.

According to the invention didactic equipment comprises voicing means, printed text with bar codes associated with at least some of the textual matter, a manually-controlled reader means for extracting information
10 from the bar codes and electronic processing means to make the voicing means in the toy articulate on the basis of the information extracted when the reader means has been passed over one of the bar codes.

Suitably the equipment also includes keyboard means
15 whereby the user can enter words into the processing means for comparison with bar code entered words. Conveniently, a visual display is provided to permit information entered by the bar code reader and/or the keyboard to be visualised.

20 The voicing means suitably comprises a loudspeaker located in a soft toy and a speech synthesiser controlled by the bar code reader. Preferably, to reduce the length of the bar codes, the speech synthesiser comprises two microprocessor means, a main microprocessor
25 means which controls a first memory serving as a word bank and a speech microprocessor means which controls a second memory serving as a bank of all the primitive sounds required for the construction of all the words to be synthesised.

30 Conveniently, part of the first memory is available for the addition of further vocabulary entered via the bar code reader.

Where a keyboard is provided, it is desirable for the processing means to be adapted to be programmed with the users name (forename or both forename and surname), entered via the keyboard during a prearranged start-up

5 programme, so that thereafter, when the equipment is first used after a downtime, the soft toy speaks that name in an initial greeting to the user.

The learning process, particularly with young children, is greatly enhanced if there is an association

10 between learning and play, and using a soft toy as a component of didactic equipment will put the learner at ease and heighten the play aspect of the learning process without detracting from the value of the latter.

By making a soft toy usable as such when dis-

15 connected from other hardware making up the equipment, a child can play with the toy in all the usual ways and can in addition get it to join with him/her in the process of _inter alia_ learning to read.

A teddy bear is a particularly convenient toy for

20 use with the invention, and the only component which need be incorporated in the bear is a loudspeaker connected to externally accessible terminal means for wiring teddy to the processing means and the remainder of the voicing means when the full equipment is to be

25 used.

Embodiments of didactic equipment in accordance with the invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

30 Figure 1 is a general view of a simple embodiment of didactic equipment for teaching a child to read and spell,

Figure 2 is an enlarged view of one page of the book shown in Figure 1,

Figure 2a is an enlarged schematic view of a bar code which could be used on the page of Figure 2, and

5   Figure 3 is a block diagram showing the electronic components of a more sophisticated piece of didactic equipment in accordance with the invention.

Referring to Figure 1, the equipment shown comprises a teddy bear 1 incorporating a loudspeaker 2; a computer

10   3 incorporating a keyboard 3a, and a visual display 3b; a special reading book 4 and a bar code reader 5.

Figure 2 shows one typical page in a first reading book 4 which includes printed matter 6 and bar codes 7a and 7b.

15   The child can use the equipment to make teddy "speak" merely by stroking the reader 5 smoothly across a bar code (e.g. the bar code 7a from left to right).

The child can also use the keyboard unit 3a to complete sentences or to answer questions posed in the text,

20   and can then use the reader on a bar code (7b) adjacent to the sentence or question to confirm whether the attempt is, or is not, correct. Confirmation can be provided either via the visual display 3a (e.g. display of a legend "NO — try again" or "well done") and/or by teddy articu-

25   lating such legends or similar phrases indicating an error or success, as the case may be.

A series of books 4 can be provided to follow a child's developing skill in reading and/or writing, or to cover a range of different subjects (such as arithme-

30   tic or geography).

Ability to spell can be tested with a series of bar codes which programme teddy to say a word which the child then has to enter into the computer 3 via the keyboard 3a in order to get teddy to congratulate a correct

5 spelling, or to encourage a further attempt in the case of an incorrect spelling.

The simple equipment shown in Figure 1 can be greatly expanded, and some of the additional units that can be used with the equipment described thus far, are shown

10 dotted in Figure 3. These include a digitising pad (permitting the development of writing skills), a visual display unit (permitting the writing or keyboarding of lengthy passages), a number cruncher (permitting mathematical questions to be posed to a user), a printer (for

15 producing hard copy output), and a modulator for feeding the output of the computer to a television set or a video recorder.

A wide variety of different bar coded arrangements are possible, and one suitable arrangement is shown in

20 Figure 2a. The arrow in Figure 2a indicates the direction of movement of the reader 5 across the code and should be in the direction in which the particular language of the book 4 is read (i.e. left to right in the case of English). The first two code lines 30 are the initial-

25 isation code of the computer 3 and are also used to prepare the loudspeaker control circuitry and the display 3b for action. The next group of codes 31 represent the address in the computer memory where the instructions for making the loudspeaker 2 articulate the required

30 word are stored (this mechanism will be more fully described later). The next group of codes 32 are the programme instructions for calling up the display of the required word on the visual display 3b and the final code (which can again be a group of bars) 33 is the finish

35 code to put the computer 3 back into a waiting condition for the next set of instructions.

If the finish code 33 is not received in a pre-set
time from reading of the initialisation code 30 (or if
the initialisation code is not the first code read),
the device indicates in some way (preferably by getting
5   teddy to articulate a "try-again" instruction) that a
new attempt at reading the code is required.

It is an important feature of preferred embodiments
of didactic equipment according to the invention, that
the computer uses two memory banks for the speech synthe-
10   sising operation, a first bank which assigns each word
in its vocabulary to a specific address and a second
bank which contains the information for a large number
of different primitive "utterances".

Speech synthesisers usually rely on storing speech
15   either as complete words (analysed by various means such
as linear predictive coding or plain amplitude/time or
frequency/time analysis of the required waveforms) or
on building up words from sound components termed
phonemes. The storage of the information for synthesising
20   complete words uses relatively large amounts of memory
space (which may be a less important disadvantage as
memory capacities increase with developing technology)
but more importantly only those words originally analysed
and built into a memory chip can be accessed. To modify
25   the vocabulary of a memory chip using full word storage,
thus involves a major reanalysis and reprogramming of
the speech synthesis chip.

Speech synthesisers that build up words from phonemes
allow a large potential vocabulary and the density of
30   word storage is high. However, as assessed by those
skilled in the art, known phoneme banks are not capable
of offering good speech quality.

What is employed in a preferred embodiment of equip-

ment according to this invention is a speech synthesising system that synthesises the speech from primitive utterances termed "primitives". Primitives are a composite collection of parts of sounds, complete sounds, phonemes and parts of words. The instructions to cause the loudspeaker to "utter" each primitive are stored in a memory bank addressed by a speech synthesiser microprocessor. Instructions to the speech synthesiser microprocessor call up the required primitives in the required order, and with the required delay between separate call ups. This arrangement allows 2000 words to be stored in 64K of memory. The bank of primitives is constant for any given language or dialect and the system is thus capable of affording great flexibility to the equipment allowing new words to be added to the computer's vocabulary by bar code entry and permits much simpler bar codes (such as 7a or 7b) to be used on the text, since the bar code merely addresses the word bank in the main microprocessor and does not directly have to address the many locations in the bank of primitives.

Shorter bar codes are important not just to facilitate their printing, but to reduce the risk of incorrect reading using the hand-held reader 5. Small children (and disabled persons) would find difficulty in traversing long codes at the required steady speed but can easily manage the shorter codes envisaged by preferred embodiments of equipment according to this invention. If all the call up instructions for the sounds required for even quite simple words are bar coded, the codes can require over 100 bars.

The speech synthesiser can be pre-programmed (e.g. via the reader 5 and/or the keyboard 3a) to articulate the input as alphabetical pronunciation of individual letters, phonetic pronunciation or pronunciation of the

full word.

Figure 3 shows, in block diagram form, how the components are arranged in equipment according to the invention. The components indicated in dashed lines are
5 optional features and will be discussed later.

The reader 5 (usually a light pen or magnetic reader) and keyboard 3a are connected to the main processor 10 of the computer 3 which powers the display 3b via a display driver 11. Via an address multiplexer 12, the micro-
10 processor is connected to a high capacity ROM 13 (32K or 64K, for example) which serves as a permanent word table for the computer and has addresses for around 1000 words which are built into the equipment on supply to the user.

15 The microprocessor 10 is also linked to a speech microprocessor 14 which in turn, via a second address multiplexer 15, is connected to a second high capacity ROM 16.

The ROM 16 contains the instructions for generating
20 around 2000 different primitives, each primitive having a different address in the ROM.

The speech microprocessor 14 is connected to an amplifier 17 which powers the loudspeaker 2.

Let is be assumed that the word "cat" requires the
25 sequential employment of the output of ten different addresses in the ROM 16 (some of which will be spaces of different duration and others sounds). The light pen 5 reads the bar code 7a for "cat". What it actually reads is the address for "cat" in the ROM 13. These
30 instructions are received in the microprocessor 10, addressed to ROM 13, which in turn addresses the speech

microprocessor 14 to call out of the ROM 16 the required sequence of ten primitives. These, fed to the amplifier 17, cause teddy to say "CAT".

Thus the speech microprocessor 14 is dedicated solely
5 to looking up the required primitives according to the instructions received from the main microprocessor 10.

The main microprocessor 10 also feeds information to the display driver 11 which forms the letters "C", "A", "T", on the display 3b which is typically a 20
10 character LCD or dot matrix LED display. Some or all of the conversion routines can be stored in the main microprocessor 10.

Using the keyboard 3a as the input, instructions can be entered into the microprocessor 10 to cause the
15 typed characters to be presented on the display 3b, and to actuate the speech microprocessor 14 to articulate either alphabetically, phonetically, or the full word typed. An additional selector control can be provided on the computer 3 to select the required mode of opera-
20 tion.

If the reader 5 is used to prepare the computer 3 for checking the correctness of a question answered on the keyboard 3a by the user, the initialisation code 30 will be different, and will call from the ROM 13 the
25 code for the required word which is the correct answer. If this code corresponds to that entered via the keyboard 3a, the microprocessor 10 will call up the approval mess- age (verbal or displayed) but otherwise will call up the message indicating an error.

30 18 in Figure 3 is an add-on RAM (or EAROM) which can be addressed by the light pen 5 on the basis of bar codes relating to additional words not in the ROM 13.

Thus, for example, when an advanced book 4 is to be used which includes words (theme words specific to that book) not in the ROM 13, the theme word bar codes can be addressed first (they could be at the back of the book) and each theme word bar code will have an initialisation code that addresses the RAM 18. The RAM 18 has a back-up battery 19 to make it non-volatile when the computer is disconnected from its normal power source (usually mains supply).

A number cruncher 20 can also be added to permit the equipment to be used for mathematical problems.

A printer 21 is a further optional extra permitting hard copy output to be obtained and this would be fed from a character generator 22 connected to the main micro-processor 10.

The character generator 22 and a video format generator 23 can be used to feed a VDU 24 or, via a modulator 25, a television set or a VCR (not shown).

The character generator 22 takes instructions from the computer 3 and converts them into the form required for the printer 21 or VDU 24. The video format generator 23 produces the necessary synchronising and timing pulse trains required to VDU interface.

Finally, to permit the user to hand write instructions into the computer, it is envisaged that a digitising pad 26 could be used.

From the above it will be appreciated that the main microprocessor 10 controls the overall operating routines of the computer 3. These include

Learning routines;

Light pen entry routines;

Keyboard polling and accessing routines;

Addressing and reading memory routines;

5   Addressing the display drive and character generator;

Addressing instructions to the speech microprocessor; and

Polling and entry routines for the digitising pad.

A further desirable feature of didactic equipment in accordance with the invention is the ability to use the
10 reader 5 in association with specially printed bar codes to provide suitable sound effects to heighten a user's interest in the text being read (e.g. animal noises).

The invention can also be used with braille text and the previous references to "printed text" should
15 be taken to include the projections which form braille letters. Since the user of braille text will probably not see the location of the bar codes, these are desirably located just above a line of braille letters so that a reader 5, attached to the "reading" finger of a user,
20 will naturally traverse the bar codes as the text is "read".

CLAIMS

1.   Didactic equipment comprising voicing means, printed text with bar codes associated with at least some of the textual matter, a manually-controlled reader means for extracting information from the bar codes and electronic processing means to make the voicing means in the toy articulate on the basis of the information extracted when the reader means has been passed over one of the bar codes.

2.   Equipment as claimed in claim 1, together with keyboard means whereby the user can enter words into the processing means for comparison with bar code entered words.

3.   Equipment as claimed in claim 1 or claim 2, together with a visual display to permit information entered by the bar code reader and/or the keyboard to be visualised.

4.   Equipment as claimed in any preceding claim, in which the voicing means comprises a loudspeaker located in a soft toy and a speech synthesiser controlled by the bar code reader.

5.   Equipment as claimed in any preceding claim, in which the speech synthesiser comprises two microprocessor means, a main microprocessor means which controls a first memory serving as a word bank and a speech microprocessor means which controls a second memory serving as a bank of all the primitive sounds required for the construction of all the words to be synthesised.

6.   Equipment as claimed in claim 5, in which part of the first memory is available for the addition of further vocabulary entered via the bar code reader.

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7.   Equipment as claimed in claim 2, in which the processing means is adapted to be programmed with the user's name, entered via the keyboard during a pre-arranged start-up programme, so that thereafter, when
5 the equipment is first used after a downtime, the voicing means speaks that name in an initial greeting to the user.

8.   Equipment as claimed in any preceding claim, together with a digitising pad for handwritten input
10 into the processing means.

9.   Equipment as claimed in any preceding claim in which the processing means includes a number cruncher.

10.   Equipment as claimed in any preceding claim, together with at least one output from the processing
15 means for one or more of a printer, a VDU, a television set or a video recorder.
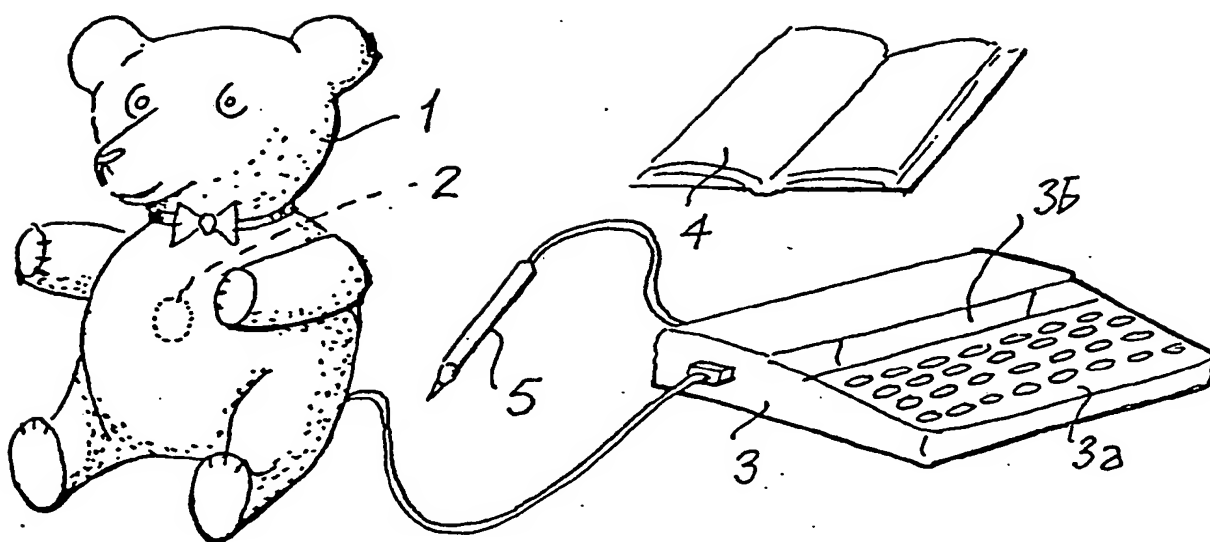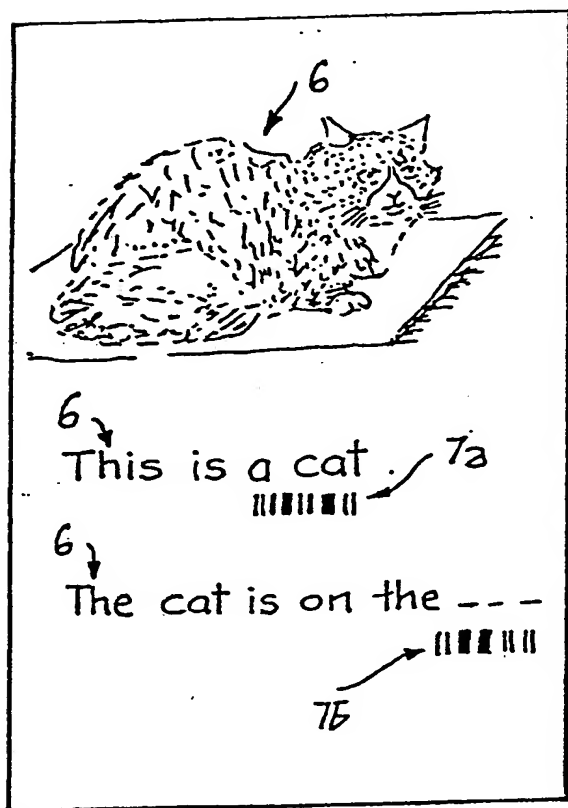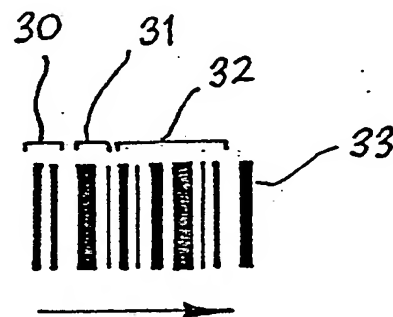
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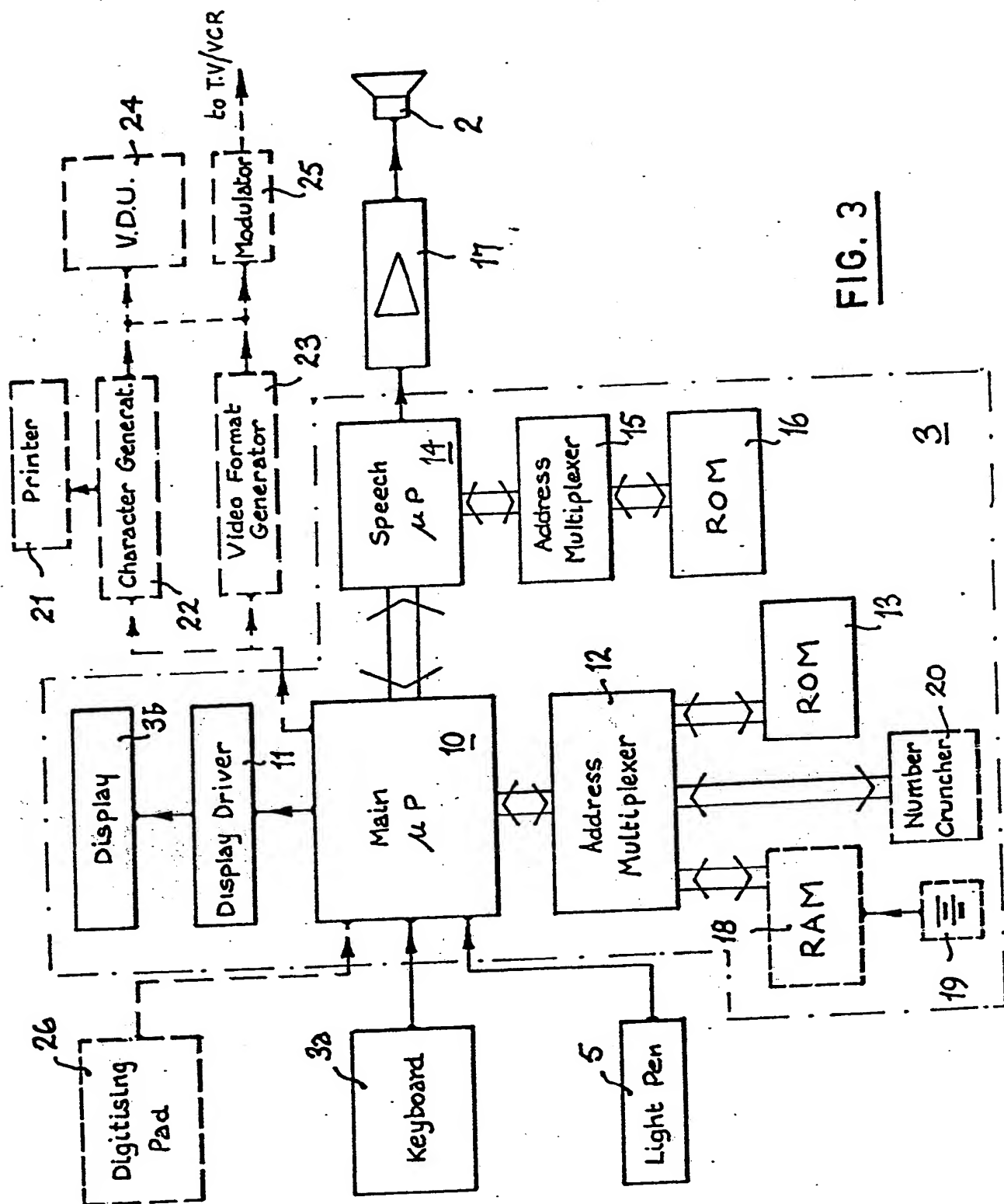

FIG.1

FIG.2

FIG.2a

FIG. 3

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 82/00344

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 8

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC³: G 09 B 5/06; G 09 B 17/00; G 09 B 11/00

II. FIELDS SEARCHED

Minimum Documentation Searched 4

Classification System	Classification Symbols
IPC³	G 09 B

Documentation Searched other than Minimum Documentation
to the Extent that such Documents are Included in the Fields Searched 5

III. DOCUMENTS CONSIDERED TO BE RELEVANT 14

Category *	Citation of Document, 16 with indication, where appropriate, of the relevant passages 17	Relevant to Claim No. 18
X,Y	IBM Technical Disclosure Bulletin, volume 20, no. 6, November 1977 (New York, US) J.T. Powers et al. "Text publishing and reading system for the handicapped", pages 2421-2422, see the entire document	1,4
X,Y	FR, A, 2458869 (N.V. PHILIPS' GLOEILAMPEN-FABRIEKEN) 2 January 1981, see figures 1-3; page 9, line 18 - page 12, line 34	1,4,10
X,Y	FR, A, 2452149 (BERTIN & CIE) 17 October 1980, see figures; claims	1,4
Y	FR, A, 2469765 (GANOUNA et al.) 22 May 1981, see figures; claims	1
Y	Information Processing 80, Proceedings of the IFIP Congress 80, Tokyo, JP, October 6-9, 1980, Melbourne Aus. October 14-17, 1980, I.D.G. MacLeod et al "A multisensory electronic system for developing handwriting skills with blind trainees", pages 945-950, see figure 1 ./.	1,4,8,10

* Special categories of cited documents: 15
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the International filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the International filing date but later than the priority date claimed

"T" later document published after the International filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search 2	Date of Mailing of this International Search Report 3
27th January 1983	08th February 1983

International Searching Authority 1	Signature of Authorized Officer 20
EUROPEAN PATENT OFFICE	G.L.M. Kruydenberg

Form PCT/ISA/210 (second sheet) (October 1981)

FURTHER INFORMATION CONTINUED FRO.1 THE SECOND SHEET		
Ẏ	EP, A, 0036559 (TEXAS INSTRUMENTS INCOR-PORATED] 30 September 1981, see figures 1,3; claims	1,2,3,4
Y	EP, A, 0040682 (TEXAS INSTRUMENTS INCOR-PORATED) 2 December 1981, see claims; figures 1,2	1,4

V.☐ OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [10]

This international search report has not been estab.ished in respect of certain claims under Article 17(2) (a) for the following reasons:

1.☐ Claim numbers _____ because they relate to subject matter [12] not required to be searched by this Authority, namely:

2.☐ Claim numbers_____ because they relate to parts of the international application that do not comply with the pre scribed require-ments to such an extent that no meaningful int ernational search can be carried out [13], specifically:

VI.☐ OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [11]

This International Searching Authority found multiple inventions in this international application as follows:

1.☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2.☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3.☐ No required additional search fees were timely paid by the applicant. Consequently, this International search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4.☐ As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

☐ The additional search fees were accompanied by applicant's protest.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (supplemental sheet (2)) (October 1981)

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